Patent Application of

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for

WIRELESS MONITORING SYSTEM OF DIAPER WETNESS, MOTION, TEMPERATURE AND SOUND

BACKGROUND OF THE INVENTION

Background-Field of the invention

This invention relates to a self-contained, reusable sensing device with a diaper for:

- Separately determine urine or feces presence in said diaper;
- Distinction between urine and feces in said diaper;
- Fullness level of urine and feces in said diaper;
- Diaper wearer motion;
- Diaper wearer sound;
- Diaper wearer body temperature.

And a wireless transmitter for relaying said conditions to a remotely monitored device.

Background-Description of the prior art

All infants up to 2 years old need diapers. 30% of the patients in care facilities such as hospitals and nursing homes or even in homes are bed-ridden or otherwise incontinent. Most important cause of diaper rash is because of too long feces and/or urine contact with diaper wearer skin. Of these two, more important is the feces contact with the skin. In order to prevent skin irritation the diaper must be changed as soon as possible after bowel movement or urination occurred. Today's infant diapers absorb more than one urination. They contain a special gel, which absorbs, hold and, up to a certain point, do not allow germs development. Feces absorb in diapers only partially and develop germs more quickly, becoming a cause of skin irritation. For parents or attendants it is most important to know when a diaper wearer bowel movement occurs or when the diaper is full. For parents or attendants is important to know when diaper wearers wake up and start to move or cry after sleep, or if they did not move at all for a while. For parents or attendants is important to know when diaper wearer body temperature becomes abnormal.

Existent electrical or electronic alarm devices signal just diaper wetness condition; no matter there is urination or feces. They do not detect separately diaper wearer bowel movement or urination. They do not sense and show the level of diaper fullness. They do not sense and show the diaper wearer motion. They do not sense and show the diaper wearer sounds and sound amplitude level. They do not monitor diaper wearer body temperature. That is why they are not used today for infants and they are used

on a small scale only in some senior facilities and some hospitals.

Objects and Advantages

The object of this invention is to provide a self contained, reusable sensing device for:

- Separately determine urine or feces presence in a diaper;
- Distinction between urine and feces in said diaper;
- Urine and feces level of fullness in said diaper;
- Diaper wearer motion;
- Diaper wearer sound;
- Diaper wearer body temperature.

Said sensing device can be used with any paper or cloth diaper in a home or in a health care facility. Once a wet diaper is detected and changed by an attendant, said device is removed and transferred to a dry, clean diaper.

A further object of the present invention is to provide a sensing device for said diaper conditions and transmitting these conditions automatically, wireless to a remotely located attendant.

A further object of this invention is to provide a system for remotely monitoring said conditions of a plurality of diapers. Such a system comprises a plurality of said sensing devices, affixed on said plurality of diapers, each being electronically encoded with a unique address and having an output coupled to a transmitter for

transmitting said conditions and said addresses. The system further contains at least a receiver for receiving said conditions and said addresses.

A further object of this invention is to provide a wireless device with display, which provides for an attendant data about said diaper conditions.

Other objects, features and advantages will become more apparent upon reading of the detailed description and drawings of the preferred embodiment of the present invention.

Drawing Figures

Fig.1 is a perspective view of diaper with a detector affixed on it;

Fig.2 is a perspective view of the detector - the against the diaper side upfront;

Fig.3 is a section view of a detector affixed on a diaper;

Fig.4 is a detailed section view of a retracted claw;

Fig.5 is a detailed section view of a penetrated through the diaper claw;

Fig.6 is a longitudinal section view of the detector;

Fig.7 is a front view of the detector, showing the mechanics of the detector;

Fig.8 is a system block diagram of preferred embodiment of the present invention;

Fig.9 is a perspective view of a diaper with both a temperature sensor and a detector attached on it;

Fig.10 is a front view of a pager display;

Fig.11 is a section view of a diaper support with a diaper and a detector on top of it.

DETAILED DESCRIPTION

Referring to Fig.1, Fig.2 and Fig.3, paper or cloth diaper **G** has affixed on it a detachable sensing device **D**, named also detector **D**. Said detector **D** has two parts **A** and **B**, united by a hinge **H**. Rounded shape of said parts **A** and **B** and said hinge allow detector **D** to stay in full contact with diaper **G**, in order to be comfortable and to allow a proper detection at capacitive sensor **CS**. On the side of said detector **D**, which stays in contact with diaper **G**, are the retractable pairs of claws **C1...C4**. Each said pair has two claws **C**. Said pairs of claws have two functions. One function is to affix the detector **D** on the diaper. Second function is each pair of claws **C1...C4** serves as electrodes for conductive sensors **S1...S4**. They measure conductivity between two claws of each pair **C1...C4**. On the center of part B is a capacitive sensor **CS**. Said sensor has two parallel plates having the shape as in Fig.2. Sensors **S1...S3** are urine sensors. Sensors **S4** and **CS** are feces sensors. There are two feces sensors of two kinds in order to be sure that at least one of them are activated when a bowel movement occurs. The explanation is that sometime feces are in liquid form and some times they have a bigger viscosity. The liquid feces activate easier the conductive type sensor. The more viscous feces activate easier the capacitive type sensor.

Referring to Fig.4 and Fig.5 a claw **C** is fixed within part **F**. Part **F** is made of nonconductive plastic material. Part **F** is fixed to the other end on shaft **SH**. Said assemble which contains claw **C**, part **F** and shaft **SH** is incased in the case of said detector **D**. The plate **PL** is a part of detector **D** housing. Said plate **PL** has two holes **H1** and **H2** for each claw **C**. Detector **D** is affixed on the diaper **G** with plate **PL** in full contact with diaper **G**. When shaft **SH** rotates an angle of about 150 degrees in counter clock direction, claw **C** exits detector **D** housing through hole **H1** and goes through diaper **G**. In the end of its course claw **C** enters hole **H2**.

Referring to Fig.6 and Fig.7, lever **L1** is fixed with shaft **SH1** and claws pairs **C1, C2**. Wheel **W1** is fixed on shaft **SH1**. Wheel **W2** is fixed on shaft **SH2**. Shaft **SH2** is fixed with claws pair **C3**. Shaft **SH1** rotation is transmitted to shaft **SH2** by wheel **W1**, a flexible rack or a cable **CA** and wheel **W2**. In the preferred embodiment I chose a cable **CA**. Lever **L2** is fixed with shaft **SH3** and pair of claws **C3**.

Referring to Fig.8 and starting from upper left, conductive sensors **S1…S4** and capacitive sensor **CS** send their analog output to microcontroller **MC1** analog to digital input ports. Said conductive sensors **S1…S4** are of usual type. Said capacitive sensor **CS** contains said transducer shown in Fig.2 and the circuitry, which measures the voltage drop on said capacitive transducer. Said capacitive sensor transducer is a capacitor with both plates in the same plane and is supplied in high frequency power supply. By its software said **MC1** analyzes the amplitude of each signal coming to its analog to

digital input from said sensors. A signal is a pulse or a slow variation voltage. If any of said signals is bigger in amplitude than a predetermined value written in said **MC1** software, said signal will go through said **MC1**. In this situation said sensors are considered activated. When the first said signal passes through said **MC1**, at the same moment said **MC1** blocks/ignores for a predetermined period of time of approximately 1 minute all other signals coming from said sensors. That way detector **D** can detect which sensor was first activated and it makes the difference between urination and bowel movement. The attendant can see if the diaper bearer urinated or had a bowel movement. Because there are three urine sensors and two feces sensors placed conveniently on diaper surface, the attendant can see the diaper is full or partially full. The analog output from the microphone circuitry **MIC** enters another microcontroller **MC1** analog to digital input. By its program **MC1** analyzes said signals amplitudes and prepares them in three categories by three predetermined voltage levels.

First said category is for microphone small output level, second is for a medium level and third is for high level. Small level output corresponds to small audio level, third category corresponds to high audio level and so on.

A micro sensor for motion detection **MS** with mercury or electrolyte, installed on the detector **D** printed circuit board, sends its output to another analog to digital input of microcontroller MC1. Said microcontroller **MC1**, by its program, analyzes the number and frequency of pulses received from motion detector MS.

A detachable temperature sensor **TS** shown in Fig.9 is attached to the detector **D** by an elastic clamp **CL**, the elastic insulated wire **IW** and a connector **TCM**. Being attached by clamp **CL** of diaper **G** belly elastic, the sensor **TS** is pressed against diaper wearer skin and its temperature read is accurate. When connector **TCM** is introduced in connector **TCF** connection between not shown temperature sensor and the measuring circuit **TSC** is interrupted and **TS** connects to **TSC**. **TSC** output enters **MC1** analog to digital output. By its program, **MC1** measures the amplitude of said output and divides it in three categories, as **MIC** output. The use of said temperature sensor is optional.

MC1 encodes and serializes said signals/pulses coming from each and all sensors, **MS**, **MIC** and **TS** and send them to a RF transmitter **T**.

A RF receiver **R** receives encoded trains of pulses and sends them to a microcontroller **MC2** digital input. **MC2** decodes and outputs pulses as is written in its program. **LED1...LED4** flash when **S1...S4** are activated. **LED5** flashes when **CS** is activated. Any of **S1...S4, CS sensors** is considered activated when said sensor output exceeds the predetermined value, written in **MC1** program. By its program **MC2** beeps buzzer **BZ** when **S4** and/or **CS** are activated or when all **S1...S4** are activated.

By its program **MC2** flashes led **MD** and beeps buzzer **BZ** if motion sensor **MS** is activated, as well as no activation occurred for 20 seconds time.

By its program **MC2** flashes led-s of audio display **AD** corresponding to activation levels of **MIC**. **MC2**, by its

program, beeps buzzer BZ when sound amplitude comes to medium level.

By its program **MC2** flashes led-s of temperature display **TD** corresponding to activation levels of **TS**. **MC2**, by its program, beeps buzzer **BZ** when diaper bearer temperature value exceeds normal level.

In order that power consumption to be maintained at a minimum level the detector **D** is power supplied only when claws are out of detector **D** case, in running position. That is easily achieved with a micro switch connected mechanically with lever **L1** movement. Micro switch turns the power on, when lever **L1** is in position shown in Fig.6. Said switch turns power off when lever **L1** is in a position rotated 150 degrees, with claws retracted in reposed position, as shown in Fig.4.

Referring additionally now to Fig.10, miniature size luminescent diodes **LED1...LED3** flash in relation to wetness urine sensors **S1...S3**. One or both diodes **LED4** and **LED5** flash when feces have activated one or both sensors **S4** and **CS**. Luminescent diodes, comprised in audio display **AD** flash in relation to the noise level received by microphone **MC**. Diode **MD** flashes in relation with motion sensor **MO**. Luminescent diodes, comprised in temperature display **TD** flash in relation to the diaper wearer body temperature level received by temperature sensor **TS**.

Operation-Fig.11

Referring additionally now to Fig.11, the attendant sets up cloth or paper diaper **G** on top of diaper support **DS** in position shown. Then said attendant sets up the detector

D on top of the diaper **G** on its longitudinal axis, in position shown in Fig.11, part **A** on diaper **G** front side and part **B** on diaper **G** back side. Then attendant, holding pressed the detector **D** on diaper **G**, rotates lever **L1** from left to right and lever **L2** from right to left. That way the claws come out from detector case, go through the diaper and come out from said diaper to enter back into said detector case through each hole **H2** corresponding to each claw. Now the detector is affixed on diaper and diaper can be dressed on the diaper bearer. The size, shape and weight of detector **D** help the diaper bearer to feel comfortable like there is nothing affixed on it. Pager is so small it can be the size of a wristwatch. It depends on electronics size. In order to be comfortable in use, detector D must be as lightweight as possible and to follow the shape of the diaper. The lightness is achieved by its small, plastic body, small electronics and a very small rechargeable battery. When not in use detector and pager seats in a support/charger as any rechargeable computer mouse.

The device monitors all the parameters a parent needs to monitor to her or his baby, or, an attendant needs to monitor on any patient.